



**Government of Russian Federation**

**Federal State Autonomous Educational Institution of High Professional  
Education**

**«National Research University Higher School of Economics»**

National Research University  
High School of Economics  
Faculty of Psychology

**Syllabus for the course**  
**« Introduction to Neuroeconomics »**  
(Введение в нейроэкономику)

Author:

Василий Ключарев, professor, [vkluharev@hse.ru](mailto:vkluharev@hse.ru)

Approved by: Department of Psychology

Recommended by:

Moscow, 2017



## 1. Teachers

**Author, lecturer:** Vasily Klucharev,

Faculty of Social Sciences, Department of Psychology, Center for cognition and decision making, senior scientist.

## 2. Scope of Use

The present program establishes minimum demands of students' knowledge and skills, and determines content of the course.

This syllabus meets the standards required by:

- Educational standards of National Research University Higher School of Economics;
- Educational program «Psychology» of Federal Master's Degree Program 030300.68, 2014;

## 3. Summary

Economics, psychology, and neuroscience are converging today into a unified discipline of Neuroeconomics with the ultimate aim of providing a single, general theory of human decision making. Neuroeconomics provides economists and social scientists with a deeper understanding of how they make their own decisions, and how others decide. Are we hard-wired to be risk-averse or risk seeking? How is a “fair decision” evaluated by the brain? Is it possible today to predict the purchasing intentions of a consumer? Can we modulate economic behaviour affecting the brain? Neuroscience allied to psychology and economics have powerful models and evidence to explain why we make a decision. Decision-making in financial markets, trust and cooperation in teams, consumer persuasion, will be central issues in this course in neuroeconomics. You will be provided with the most recent evidence from brain-imaging techniques (PET, fMRI and TMS), and you will be introduced to the explanatory models behind them.

## 4. Learning Objectives

Learning objectives of the “Introduction to Neuroeconomics” class are to provide students with the new multidisciplinary approach to study decision-making. Students will learn:

- 1 Assumptions of Neuroeconomics
- 2 Methods of Neuroeconomics
- 3 The functional role of various brain regions in decision-making
- 4 Evolutionary approach of Neuroeconomics
- 5 Neuroeconomics of decisions in groups

## 5. Learning outcomes

After completing the study of the “Introduction to Neuroeconomics” the student should:

- Know the brain models of decision making and choice, neuro-cognitive models of the choice: comparison with formal models of decision making
- Understand neural representation of the subjective value, basal ganglia and choice value.



- Understand the affective mechanisms of decision making
- Understand neural mechanisms of decision making under risk
- Understand social and evolutionary perspectives in Neuroeconomics

After completing the study of the discipline «Digital signal processing» the student should have the following competences:

<b>Competence</b>	<b>Code</b>	<b>Code (UC)</b>	<b>Descriptors (indicators of achievement of the result)</b>	<b>Educative forms and methods aimed at generation and development of the competence</b>
The ability to reflect developed methods of activity.	SC-1	SC-M1	The student is able to reflect developed cognitive neuroscience methods to psychological fields and problems.	Lectures and tutorials, group discussions, presentations, paper reviews.
The ability to propose a model to invent and test methods and tools of professional activity	SC-2	SC-M2	The student is able to improve and develop multidisciplinary models of decision-making	Classes, homeworks
Capability of development of new research methods, change of scientific and industrial profile of self-activities	SC-3	SC-M3	The student obtain necessary knowledge in neuroeconomics methods	Homeworks, paper reviews, additional topics
The ability to describe problems and situations of professional activity in terms of humanitarian, economic and social sciences to solve problems which occur across sciences, in allied professional fields.	PC-5	IC-M5.3_5.4_5.6_2.4.1	The student is able to describe psychological problems in terms of neuroeconomics	Lectures and tutorials, group discussions, presentations, paper reviews.
The ability to	PC-8	SPC-M3	The student is able to	Discussion of paper reviews;



Competence	Code	Code (UC)	Descriptors (indicators of achievement of the result)	Educative forms and methods aimed at generation and development of the competence
detect, transmit common goals in the professional and social activities			identify neuroeconomics aspects in psychological and neurobiological research tasks. Suggest a method to tackle the problem and rank several available techniques in the order of applicability in the current situation	cross discipline lectures

## 6. Place of the discipline in the university's program structure

The course introduces an interdisciplinary perspective on economic choice behaviour. We are looking for students who want to go the extra mile in understanding decision making from a biological perspective; eager to learn more about how neuroscience can revolutionize economics. All students that are interested in the neurobiological underpinning of choice behaviour and financial decisions are encouraged to participate; there are no requirements of specific background knowledge.

### Prerequisites

The course is based on the basic knowledge of social and natural sciences. There are no requirements of specific background knowledge.

### Comparison with the other courses at HSE

This class is unique in both the scope and the level of delivery that assumes only very basic background in economics and neuroscience.

## 7. Schedule

One pair consists of 2 academic hours for lecture or 2 academic hours of practical session (seminar) Please, see the Course description section for assignment of lectures.

## 8. Requirements and Grading

Type of grading	Type of work	Characteristics	
		#	
	Group Task (GT)	1	Making group presentations
	Class participation	2	Attendance of classes
	Final exam (FE)	3	Written exam, 120 min



Final	Grade formula	$0.3*GT + 0.7*FE$
-------	---------------	-------------------

Note:

- **you cannot miss more than three classes**
- for Group Task you can assign a different number of points (not more than 10) to different group members to support the most active people. Example: 8 (Result of the Group X) x 5 (Number of people in the Group X) = 40 In this case you can distribute 40 points between group members depending on their contribution.

## 9. Assessment

*The group task* consists of 15 min PowerPoint presentation followed by 15 min group discussion. The teacher can suggest additional tasks.

*Final assessment* is the final exam. Students have to demonstrate knowledge of neuroeconomics theory, studies and methods.

### Grading:

Group assignment (Group Task) with a presentation at the Seminar – 30% of final mark

Written exam – 70% of final mark

You cannot miss more than three classes.

The grades are rounded in favour of examiner/lecturer with respect to regularity of class and home works. All grades, having a fractional part greater than 0.5, are rounded up.

**Academic integrity policy** Cheating, plagiarism, and any other violations of academic ethics at HSE are not tolerated.

**Table of Grade Accordance**

Ten-point Grading Scale	Five-point Grading Scale	
1 - very bad 2 – bad 3 – no pass	Unsatisfactory - 2	<b>FAIL</b>
4 – pass 5 – highly pass	Satisfactory – 3	<b>PASS</b>
6 – good 7 – very good	Good – 4	
8 – almost excellent 9 – excellent 10 – perfect	Excellent – 5	

## 10. Schedule and Course Description

Time: 18:10-21:00



Period: 20.01 - 10.03.2017 + 07.04 - 21.04. 2017

A preliminary list of lectures:

**20.01.2017**

*Lecture 1: Introduction. Introduction to the course, historical overview of the field  
Brain anatomy and functions. Introduction to neuroscience, brain anatomy and brain functions.*

*Lecture 2: Measuring brain activity: Brain-imaging (EEG, MEG, fMRI), brain stimulation (TMS), cell recording, data visualization, interpretation of the results.*

**27.01.2017**

*Lecture 3: Introducing brain models of decision-making and choice. Neuro-cognitive models of the choice: comparison with formal models of decision-making.*

*Lecture 4: Neural representation of the subjective value, basal ganglia and choice value*

*Seminar:*

**03.02.2017**

*Lecture 5: (Guest Lecture) Behavioral economics foundation of Neuroeconomics by Ksenia Panidi*

*Seminar:*

*Group 1 Heekeren, H.R., Marrett, S., Bandettini, P.A., and Ungerleider, L.G. (2004). A general mechanism for perceptual decision-making in the human brain. Nature 431, 859-862.*

*Group 2 Philiastides MG, Auksztulewicz R, Heekeren HR, Blankenburg F. Causal role of dorsolateral prefrontal cortex in human perceptual decision making. Curr Biol. 2011 Jun 7;21(11):980-3.*

**10.02.2016**

*Lecture 6: Dual process theory of decision-making*

*Seminar:*

*Group 3 Plassmann H, O'Doherty J., and Rangel A. Orbitofrontal Cortex Encodes Willingness to Pay in Everyday Economic Transactions The Journal of Neuroscience, 2007 27(37)*

*Group 4 Harbaugh, W. T., U. Mayr, et al. (2007). Neural responses to taxation and voluntary giving reveal motives for charitable donations. Science 316(5831): 1622-5.*

**17.02.2017**

*Lecture 7: Affective mechanisms of decision-making*

*Seminar:*

*Group 5 John M. Coates, Mark Gurnell, and Aldo Rustichini, Second-to-fourth digit ratio predicts success among high-frequency financial traders PNAS 2009 vol. 106 no. 2 623–628*

*Group 6 Sapienza P, Zingales L, Maestripieri D. Gender differences in financial risk aversion and career choices are affected by testosterone. Proc Natl Acad Sci USA. 2009 Sep 8;106(36):15268-73.*

**03.03.2017**

*Lecture 8: The social brain: Games in the brain.*



*Seminar:*

Group 7 Kosfeld M, Heinrichs M, Zak PJ, Fischbacher U, Fehr E (2005) Oxytocin increases trust in humans. *Nature* 435: 673–676

Group 8 De Dreu, C. K., Greer, L. L., Handgraaf, M. J., Shalvi, S., Van Kleef, G. A., Baas, M., et al. (2010). The neuropeptide oxytocin regulates parochial altruism in intergroup conflict among humans. *Science* 328, 1408–1411.

**10.03.2017**

Lecture 9: Taking an evolutionary perspective: the ‘economic animal’ Primate studies of economic behaviour. *Animals’ economy - a model of human economy.*

*Seminar:*

Group 9 Lakshminaryanan V., Chen K. and Santos L. Endowment effect in capuchin monkeys *Phil. Trans. R. Soc. B* (2008) 363, 3837–3844

Group 10 Rosati AG, Hare B. 2013. Chimpanzees and bonobos exhibit emotional responses to decision outcomes. *PLOS ONE* 8:e63058

**07.04.2017**

Lecture 10: (Guest Lecture) “Foraging theory” (economic behavior of animals) by Andrey Tchabovsky

*Seminar:*

Group 11 Izuma K, Saito DN, Sadato N. Processing of social and monetary rewards in the human striatum. *Neuron*. 2008 58(2):284-94.

Group 12 Fliessbach, K., Weber, B., Trautner, P., Dohmen, T., Sunde, U., Elger, C.E., and Falk, A. (2007). Social comparison affects reward-related brain activity in the human ventral striatum. *Science* 318, 1305-1308.

**14.04.2017**

Lecture 11: Decision making under risk

*Seminar:*

Group 13 Nikolova YS, Ferrell RE, Manuck SB, Hariri AR. Multilocus genetic profile for dopamine signaling predicts ventral striatum reactivity *Neuropsychopharmacology*. 2011 Aug;36(9):1940-7.

Group 14 Sapra S, Beavin L, Zak P. (2012) Combination of Dopamine Genes Predicts Success by Professional Wall Street Traders. *PLoS ONE*, v.7

**21.04.2017**

Lecture 12: (Guest Lecture) “Neurophilosophy” by Damil Razeev

*Seminar:*

Group 15 A.F. Shariff, J.D. Greene, J.C. Karremans, J. Luguri, C.J. Clark, J.W. Schooler, R.F. Baumeister, and K.D. Vohs *Free Will and Punishment: A Mechanistic View of Human Nature Reduces Retribution* 2014 *Psychological Science*.

Group 16 Soon CS, Brass M, Heinze HJ, Haynes JD Unconscious determinants of free decisions in the human brain *Nat Neurosci*. 2008 May;11(5):543-5.

### 11. Term Educational Technology

The following educational technologies are used in the study process:

- lectures
- discussion and analysis of the results of the home task;
- individual education methods, which depend on the progress of each student;

Students are required to show active participation in the course by giving presentations and by handing in questions about the literature before the start of each class. The basic concepts of the course will be examined by a written exam. Also, small teams of students will work on a literature study of their own choice that will be presented at the end of the course.

### 12. Recommendations for course lecturer

Course lecturer is advised to use interactive learning methods, which allow participation of the majority of students, such as slide presentations, combined with writing materials on board, and usage of interdisciplinary papers to present connections between neuroeconomics, economics and psychology.

### 13. Recommendations for students

The course is interactive. Lectures are combined with classes. Students are invited to ask questions and actively participate in group discussions. There will be special office hours for students, which would like to get more precise understanding of each topic. The course introduces an interdisciplinary perspective on economic choice behaviour. We are looking for students who want to go the extra mile in understanding decision making from a biological perspective; eager to learn more about how neuroscience can revolutionize economics. All students that are interested in the neurobiological underpinning of choice behaviour and financial decisions are encouraged to participate; there are no requirements of specific background knowledge.

### 14. Preliminary list of exam questions

Describe the rules of the ultimatum game. How is it useful to study economic rationality)?

What is the firing rate?

What is the BOLD signal? How is the BOLD signal related to actions potentials and to fMRI method?

Describe basic principles and advantages (disadvantages) of the method:

- Lesions
- Electrical stimulation of the brain
- Transcranial Magnetic Stimulation – TMS
- Electrophysiology (cell recordings)
- functional Magnetic Resonance Imaging – fMRI

Explain the following terms:

- Voxel
- BOLD

Explain:

- ‘diffusion’ model of decision making

Illustrate decision making properties of LIP (decision-making) neurons. Why do we call LIP neurons –decision making neurons?





Please explain the following terms:

- Ordinal utility
- Cardinal utility

Explain the functional role of the orbitofrontal cortex

Explain basic findings of wine experiment: Plassmann, et al (2008) “Marketing actions can modulate neural representations of experienced pleasantness. “

Indicate the location of the ventral striatum/nucleus accumbens

What does dopamine neurons’ activity code?

What is a dopamine neuron?

What is dopamine?

Explain phenomena of self-stimulation

Explain the functional role of the nucleus accumbens

Explain the functional role of ventral striatum/nucleus accumbens , give examples

Explain results of the article Bechara, A., Damasio, H., Tranel, D., and Damasio, A. R. (1997). Deciding advantageously before knowing the advantageous strategy. *Science* 275, 1293-1295.

Explain the Iowa Gambling Task.

How impaired is the behavior of (Damasio’s) patients with damage to the ventromedial (orbitofrontal cortex) prefrontal cortex

What is the somatic-market hypothesis, and who formulated it?

What is a dual system approach to decision making?

What is “dual processing”? Give neuroeconomics evidences of “dual processing” in the brain.

What is Temporal discounting (inter temporal-choices)?

Explain dual system approach to temporal discounting by McClure et al., 2004

Define risk, uncertainty, ambiguity.

An anticipatory affect model of risk (Brian Knutson)

What is “Decision under risk”?

Describe the Prisoner's Dilemmas

What are mirror neurons?

Lecture N8) Describe modulation of the empathy-related responses when observing an unfair person.

Describe Empathy for pain experiments by T. Singer et al. (2004)

Explain the idea of Biological Markets (give an example)

Explain how to trade with capuchins monkeys. Do capuchins obey price theory, do they maximize expected value? (illustrate)

What is the Endowment effect?

Be prepared to explain the results of all papers discussed in the seminars.

## 15. Reading and Materials

Unfortunately, there is no single book and we will draw from a range of books listed below.

## 16. Required Reading

Paper for seminars (see section 10)



### **17. Recommended Reading**

Literature will be made available to the students by means of electronic articles. The required literature will include:

- selected chapters from the Handbook of “Neuroeconomics: Decision Making and the Brain” by Paul Glimcher et al. (2008).
- selected chapters from handbooks on anatomy and brain imaging methods
- journal articles in neuroeconomics, selected for their clarity and accessibility

All readings can be accessed through the website/email. The quality of this seminar depends on everyone attending class, participating in discussion and doing the readings. Assigned readings should be completed before coming to class.

### **18. List of papers for review**

Will be provided as the class progresses

### **19. Course support**

Students are provided with links on relevant papers, tests, electronic books, articles, etc.

### **15. Equipment**

The course requires no special equipment

Lecture materials, course structure and the syllabus are prepared by Vasily Klucharev